Ways to develop Victorian private forestry:
Report from a study trip over May & June 2006

This study trip provided information, helped by and adding to information from two previous trips. The information sought was to better equip non-industrial private forest (NIPF) owners to be able to manage, produce and market the products of their forest or woodlots at a profit.
The study was also into sustainable management, and processing of harvest waste for bioenergy, as practiced in Scandinavia. It also looked in some detail at smaller scale machinery available commercially in the USA and Scandinavia.
It collected other information, including on the formation of government policy, and of tax and other incentives used to promote private forestry and the general forestry processing industry, where relevant to the development of private forestry in Australia.
And lastly it was to attend three conferences. These were -
the Smallwood conference in Richmond, Virginia, with 225 delegates from most American states, and looking at value-adding to smalldiameter harvested timber. This conference included entry to the immediately following East Coast timber and wood handling machinery expo.
The World Bioenergy conference in Jonkoping, Sweden. This is now the world's leading bioenergy conference and was held concurrently with a significant pelleting conference and a waste and recycling conference. The trade sites of the three conferences were adjacent.
The IUFRO 3.08 group annual conference in Galway, Ireland, with the topic of *Small-scale forestry and rural development*.
Through the conferences, and while in Finland and the Scandinavian countries, I was also looking for information for specific requests on pelleting machinery, lower cost harvesting and handling systems, and on biofuel production options.
Finally, I was making and maintaining contacts useful for gathering further information, for assisting others wanting to study the NIPF sector in these countries, and for adding to their knowledge of our fledgling industry in Australia.
This trip was able to be made with the assistance of generous funding supplied by the Central Victorian Farm Plantations Committee (CVFP), Rural Industries Research and Development Corporation (RIRDC), Farm Forestry North East (FFORNE, and the Central Highlands Agribusiness Forum (CHAF).
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'We see a town spreading from the nearby hills down to the vast treeless plain branded by slashing and burning, and furrowed by the plough into fertile farming land. Observe the endless monotonous plains bounded only by the low ridges there in the distance.' Famous Finnish writer, Zacharias Topelius, on the area of Mikkeli in 1873.

Now in 2006, a mere two rotations later, a forest of spruce, fir, birch and pine totally covers the extensive plain, and presses against the town of Mikkeli. The same reforestation has occurred across most of Finland from the same period and continues today. Almost all this was by farmers, and it displaced stock and cultivation.
What has inspired this dramatic change in the landscape that makes Finland now the most forested country in the EU? What has driven the industrial development that sees Finland a leader in fine paper production and earning up to 40% of export income from the 'forestry cluster'?
What has fostered the production by this small country of so much of the timber harvesting and processing machinery used around the world?

Background reasons for this study trip.

Cost-neutral thinning and lower cost equipment.

Post-2001 plantings of hardwood sawlog species in Victoria are approaching first thinning stage. They are generally in widely dispersed sites, and of a number of species. It is preferable that the landowners are able to have the thinning done for no net outlay. In order to achieve this the systems for thinning and handling have to be different to the standard large-scale pine thinning and harvesting.

Scandinavian and Finnish forest management associations generally manage to perform cost neutral thinning. While their scale of forestry allows greater use of large machines, Finland particularly is the source of much of the less costly equipment, based on the forestry tractor and drawn forwarder.

Marketing

One key to the cost-neutral thinning, given suitable machinery, is the effective marketing of the product at a satisfactory price. This also requires that processing and handling of thinnings into processed product is efficient, and that the market is relatively local. Firewood and woodchip are the two main options for most thinnings, and the North Americans, the Finns and Scandinavians have developed equipment that can provide us with useful options.

Woodchip fuel and biomass.

The market for woodchip and pellets in Australia is undeveloped, but the opportunity for woodchip and pellet-fuelled heating (and cooling) systems is great. New models of both domestic heating systems and larger institutional heating systems are able to make good use of the dense chips available from these first thinnings. The economics require that the chip size and shape be suitable, and that this requires use of particular configurations of chipper. Chipping is one way to process the lowest grade thinnings and harvest waste, but again the economics of handling is an issue, and this has been tackled at various scales in these countries. Work has also been done on the issues of removal of nutrient from the forest site in the form of leaves and bark.

Sustainable management

All countrys' forest owner associations have sustainable management as a key policy. In effect this requires a certification system that warrants that management on all sites is performed to the required standard. One way of ensuring this is to have the forest owner association do the basic mapping, planning and overseeing of the site works. In practice, in Finland and the Scandinavian countries, the associations do most of the work for the forest owner in return for either a fee per hectare, plus in most countries charging a commission on sale of product. Embedded in this full service is the certification process, with the association usually working in close liason with the relevant government department, and with an auditing organisation such as Norske Veritas.

Association functions and income streams

In working with association employees and meeting with association board members, it is clear that while the associations in different countries have quite different approaches, they are able to generate significant income. This may be invested in regional timber processing, returned to members as a rebate or share distribution, and used to improve training and services. While each forest owner member may only have a small total of forest in a number of parcels down to tenths of a hectare, the totals of thousands of members' holdings means that considerable wood volume flows annually through an association's system, and into the larger economy. The rules of each country's associations spell out different commercial limitations.

Public good and private benefit

Study of this issue (a controversial issue in Australia but not in Scandinavia) is complicated by the Everymans Right concept in Finland and Scandinavia. This Right allows anyone to wander private forest gathering fungi and berries for private consumption, and for recreation, including camping in transit. The preservation of water quality, and of sites like springs or historical relics, and of wildlife habitat, is incumbent on forest owners, and strictly enforced.

The Finns and Scandinavians realise that public good can be quite compatible with private benefit. In fact, that public good is often generated by, and can even be inseparable from, private benefit.

Itinerary

May 14th fly Melbourne – Sydney - LosAngeles - Charlotte NC – Richmond Virginia.

USA

May 16-18 Attend **Smallwoods conference** and tour

Sat May 19 - Attend **East Coast timber machinery equipment Expo**

May 21/22 – Fly Richmond – Washington – Copenhagen

Denmark

May 24/26 – travel with two foresters of Zealand forest owners association, visit sites, interview on management, attend **Rosskilde agricultural fair**, meet with Danish farmers' association reps, collect information on available farm forestry machinery, and pellet heating systems

May 27/28 visit community recycling centre, CHP plants using biomass, windfarms, sewage treatment plant in Copenhagen area

Mon May 29 – Train Copenhagen to Jonkoping, central Sweden.

Sweden

May 30/June1 – attend **World Bioenergy conference**, Jonkoping. Field trips to Jonkoping biogas plant and CHP plant using municipal waste, forestry harvest site -biomass chip and bundling demo.

Fri June 2 – train to Vaxjo, interview bioenergy specialist at Commune offices, to Varnamo and visit Bruno Matssen furniture design gallery. Visit two other furniture businesses.

Sat June 3 – train via Goteborg (visit outdoor furniture display centre) to Stromstrand

Norway

Sun June 4 – ferry to Sanderfjord Norway, train to Tonsberg

Mon June 5 – train to Skien, meet with chief forester for AT Skog

Tues June 6 – Visit various sites with AT Skog certification compliance officer

Wed June 7 – Visit harvest and thinning sites in Notodden area with chief AT Skog forester. Stay with director of Gjerpen forest owners association. Visit forest. Interview re management.

Thurs June 8 – train to Oslo, fly Oslo – Helsinki, Train to Lathi.

Finland

Fri June 9 – Train Lathi to Suonenjoki. Stay with director of Siso-Savo forest owners association

Sat June 10 – Drive to Joensuu, day at **Nayttelyopas bioenergy and forestry machinery expo**.

Sun June 11 – drive around forest owner's sites and interview re management etc.

Mon June 12 – Drive to Savo Voima community heating plant, to forest site for truck mounted chipping operations, interview Northern Savo Forest Union bioenergy specialist enroute to Kuopio – interview EO of Northern Savo Union. Train to Suonenjoki.

Tues June 13. Visit Suonenjoki Siso-Savo branch Forest Management Association offices, interview the association's marketing and communications officer. Attend Siso-Savo Forest Management Association officers' field training session. Train to Lathi

Wed 14 June – Visit Sibelius Hall (largest new wooden building in Finland). Train to Helsinki, Fly to Copenhagen.

Denmark

Thurs 15 – visit Ministry of the Environment, interview, collect literature on Danish forestry

Fri 16 – To Rosskilde, visit Hoje-Taastrup Commune recycling centre and municipal CHP plant.

Ireland

Sat 17 – fly to Dublin, bus to Galway

Sun 18 –

Mon 19/22 – **IUFRO conference- *Smallscale forestry and rural development,*** and tour. Attend, deliver paper, chair final forum.

Fri 23/24 – bus to Dublin, Fly Dublin – Frankfurt – Seoul

South Korea

Sun 25 – bus to Daegu, south east Korea

Mon 26 – drive to Gyeonju and tour forest areas. Visit Tohamsan Recreational Forest

Tue 27/28 – train to Seoul, Fly Seoul – Singapore – Melbourne

Report

As usual this study trip has raised as many questions as it has produced answers. For instance –

Q. How can a non-industrial private forest timber industry be stimulated?

A. 4% to 40% of the income from harvesting in Norway can be invested in the Forest Trust Fund (interest generated goes back to the government). It is not taxed going in. Nor is it taxed coming out, provided it goes into forestry improvement work like thinning, roads or planting. It is widely used. Many farmers leave harvest income in the trust for up to five years. This approach means that profits generated from forestry are re-invested in private forestry infrastructure and growing stock. Income averaging, and stimulation of timely thinning by tax incentives are used elsewhere.

Q. What is the potential for woody biomass in a national energy sector, and what place could it play in generating a more vigorous farm plantation sawlog sector in Australia?

A. At the World Bioenergy Conference in Sweden woody biomass was repeatedly identified as the main future source of biofuels derived though pyrolysis. Dimethylester (DME) is likely to be a major part of this fuel output. While canola oil can be a base for biodiesel, sugar and starch-rich plants for ethanol production, and green fresh pasture for biogas production, the availability of agricultural ground is a limiting factor in producing adequate volumes of biofuels, at least in Europe. Up to 75% of biofuel feedstock volumes will need to come from woody biomass, and at lower unit costs, given the solving of several key technical steps.

Q. How have the Finns – a country of only 4 million, half within the arctic circle, and with a widely dispersed, privately held forest resource – managed within 30 years to become a leader in forestry machinery manufacture, paper manufacture, export of technology and expertise?

A. The Finns have three bodies that together direct investment into higher education, research and development, and industrial expansion. They have held to this course through successive governments over 30 years. In short, they have long range strategic vision backed by legislation, and administered by competent committed people. This situation is helped by having such a high ownership of private forestry (20% of the population) and by having the management of forestry largely in the hands of private owners. See www.tekes.fi and www.tekes.fi/opet for information.

Q. What are the inputs of a sustainable non-industrial private forestry industry to the rural economy?

A. Agder-Telemark Skog in south east Norway has 8500 forest owner members with 400,000 ha. It has an average turnover of about 450 million Norwegian Kroner (NOK), or about A$95 million from harvests of about 1 million m3 of sawlog, pulplog and fuelwood. It employs about 40 people. It is governed by a grower board that is drawn from its 54 local forest owner groups.

While timber industry businesses decisions to come and go are driven by purely commercial motives, AT Skog has invested into regional industry to maintain viability and ensure a market for its wood product. It returns its large profits back to the 54 grower groups.

It takes a longer view than most processing industry. It is an investor into a cutting-edge biofuel reseach project, based on woody biomass pyrolysis, along with Norske Skog and Norske Hydro. It is a contributor to setting up the training organisation that serves the growers.

Q. What impacts does a sustainably managed NIPF industry have on water runoff, water quality, wildlife habitat? Is sustainable production compatible with recreation and public access?

A. Water quality and wildlife habitat are clearly enhanced, protected, and well monitored within the NIPF industry. Recreation is bound up with the Everymans Right giving access to all to forest to hike, camp and gather berries and fungi. In southern Scandinavia and Finland, despite rainfall of around 800mm, run-off from extensive managed forest feeds extensive lakes and river systems. It appears that re-forestation since 1900 has not reduced rainfall and run-off, but if anything, has resulted in an increase.

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Summary of approaches to NIPF country by country, with apparent trends

USA.

The 2006 State of the Union address mentioned biomass prominently. The impact of Hurricane Katrina, in what was already a particularly bad hurricane season, along with international instability due to the Iraq war and Muslim extremist activity, has meant that prices of fossil fuels in May 2006 had risen significantly (to about US$3/gallon, or about A$0.80/litre). Pressure on state and federal politicians to reduce fuel prices had resulted in a range of options being floated including resuming exploration on the continental shelf in the Gulf of Mexico, and in the Alaskan wildlife reserves. The federal aim as stated by President Bush is to have reduction of imports of Arabian crude oil by 75% by 2025, and 30% of transport fuel needs (mainly as ethanol) being produced within the country by 203o. This would require production of about 60 billion gallons of ethanol equivalent. The ethanol interim production target is of 12 billion gallons to be produced by 2012. Production is already presently ahead of schedule with about 4 billion gallons (20 billion litres) being produced in 2005/6 (the equivalent of the annual Australian petrol consumption).

Woody biomass is seen as playing a real role in achieving this longer-term goal, with research proceeding on the technology involved in the breaking down of complex lignin and cellulose chains of woody material. Another aspect of this and as part of a response to the increasing damage from wildfire is the thinning work that is being done on federal forests, with up to 27 million acres already thinned in the more fire-prone states. About 25% of this thinning produces biomass economically available for processing as roundwood or conversion to chip.

Schools and universities, among other institutions, are being encouraged by federal and state cost share subsidies to convert from oil and electric heating to biomass heating, generally using woodchip. Generally forest owner associations do not play a significant role in NIPF harvest and marketing, though they are more visible in stewardship planning, and forest certification.

It can be expected that the 2007 American Farm Bill will continue the emphasis of making better use of national bioenergy resources, including funding for work on producing ethanol from lignin – cellulosic material, and on gas pyrolysis (break down of woody biomass with heat and extraction of hydrogen rich gases). As well the ongoing production of ethanol from corn will continue on its trend line. Increasingly petrol in the USA is available as a blend with ethanol, including to the 85% ethanol content. Commercial trials are being conducted by large power companies on mixing woodpowder and woodchip with coal to attain the environmental goals.

Denmark

Denmark, with about 5 million people, has excellent public transport, near-total recycling, a history of industrial design excellence, and a very high level of renewable energy production. It has a policy of no nuclear power. Petrol price is about 9.50 Danish Kroner or A$2.25/litre. Denmark aims

to have no fossil fuels used by 2030. This will be achieved by a mix of bioenergy, wind, solar and wave power. Planning papers maintain that crops to produce in excess of the country's energy needs, or 40-100 million tonnes of oil-equivalent, would require 20% of Denmark's arable land.
Much of the domestic or industry heating comes from the community plants, or larger combined heat and power generating stations. The hot water these produce is reticulated through the community and into heat exchangers in houses, apartment blocks and businesses. The cooled water returns to the power station and is reheated. The power stations may use biomass, flammable household waste, or a mix of these with coal.
Denmark leads the world in use of straw as biomass, has arguably the highest proportion of its energy from wind power per capita, and has developed many community power plants using fermented animal waste and plant material, producing biogas. Production of biogas is shown to cut down dramatically on agricultural methane output from internally housed animals.
Forestry management for small-scale forestry owners is by nine independent branches of the Danish forestry extension service. This is government supported but independent, and governed by grower councils. It provides services to members, and also contracts services to other individuals and businesses on the open market. Denmark has increased forest cover from about 2% to about 11% over the last 100 years, and aims to increase cover to about 20% over the next 100 years. Much of this intended increase will be of mixed native species plantings, for the range of environmental reasons including water quality, habitat, recreation and aesthetic amenity, with production of timber and biofuel as an accompanying output.
Denmark's thorough-going philosophical approach is demonstrated by the remarkably widespread use of bicycles which rivals or surpasses that in Holland. Well-designed and ubiquitous bike lanes, commuter bike parking shelters and railway carriage design allows all levels of society to use bicycles to a high degree in cities, towns and country.

Sweden
The CO2-e output per citizen in Sweden at 6 tonne is only about half of the EU average of about 11 tonne. This lower figure reflects a number of important efficiencies. Central heating for communities, excellent public transport, power generation using flammable municipal waste, good building insulation and design. Some municipalities, such as Vaxjo in central Sweden, claim to have reduced CO2-e output to about 3.5tonne/person, by combining the range of possible actions. This lower national emissions output is also partly due to the 20% percent of national electricity produced by the remaining 7 nuclear plants.
Sweden has firm targets for reducing dependence on imported energy. By 2025 they aim to have replaced imported oil with biofuels. As an example of their progress the country is highly geared for using flammable household waste as fuel, with some communities producing up to half their power and heat requirement from this source. Other communities are using organic waste, including greywater, animal waste and human sewage, to generate biogas for heating and transport fuel. Biogas production is over 16million m3, and is able to be purchased in up to 100 fuel retail outlets. Petrol price/litre is 12 SEK, 85% ethanol is 7.5SEK.

Norway
Of the 325,000km2 total area of the country, about 75,000 km2 is production forest (defined as forest having an MAI of over 1m3/ha/year! In their terms they also state it as producing more than 100 litres of wood per decahectare). In Norway overall about 90% of the forested land is privately owned, and in the south it is closer to 95%.
Norway has a principal forest owners association with nearly 70,000 members. A second association, called NorSkog, consists of 200-300 forest owners with large holdings. The State-owned holdings are represented by a third organisation.
The place of forestry in Norway has changed dramatically since WW2. '*Forestry was the most important industry in Norway till 1950. Foresters had special uniforms and high status. Now forestry is just a job, and not seen as a great career choice for young people.*'

Norway used to have three faculties of forestry in the 1970s producing up to 100 graduates a year. Now the single remaining faculty is producing 5-10 annually, down from about 50 previously.
Up to 40% of income from a forest harvest can be invested in the Forest Trust Fund. No tax is paid on funds deposited, and no tax is paid on withdrawal provided it is invested in the landowner's forestry improvement such as roading, planting, drainage or thinning. Interest accruing on the Forest Trust funds go into government revenue.
While use of woodchip or pellets for bioenergy is relatively minor, firewood production and sale is visible everywhere. This is usually produced from hardwood thinnings, principally from birch. Price of firewood in netting packs on pallets is about 600 Kroner per 0.5m3 of solid volume (or about A$200/airdry tonne). Due to the extensive share in North Sea oil and gas fields, and its established hydro power generation, Norway is relatively late in developing its biofuel options.

Finland

Forest is about 65% private owned in Finland, with 'private' meaning non-industrial, family-based ownership. The balance is the church, communes, and the government. Up to 20% is set aside in permanent reserves. At the back of all forestry management is an evolving legislation, beginning with the Forest Act of 1886. This stipulated how every forest owner has to manage sustainably. Clear cutting was totally prohibited. Without this act Finland may have become as denuded as England, Ireland, Holland or Denmark (or Australia).
The outcome has been that Finland has reverted from about 25% forest cover to about 70% and has a forestry cluster of industries providing up to 40% of export income. 80% of industry's logs come from family forests. Research into forestry and wood technology employs about 3000 people.
Finland, with its population of about 4 million, is a leader in plywood and fine paper production, and also in the production and export of machinery for timber harvest and processing. These businesses and trade names include Valmet, Ponsse, Timberjack, Kara (Kesla), Patu (Kesla), Hewsaw (Veisto), Lannen, Potti Putki, Haaki Pikku, Hiko, Narva, Arbro (Metso Metalli), Hakmet (Metso Metalli), Mecanil, Nokka, and Kronos. Global Finnish paper, plywood and sawmilling businesses include UPM Kumera, Stora Enso, and Metsalitto.
Finland has no ethanol or other commercial biofuel production industry, but is a leader in the use of woody biomass for energy production. In much of the country each community has a heating plant producing hot water for reticulating around the community and heated by woodchip. Presently Finland is exporting most of its pellet production, with no excess sawdust coming into the market. One area of demand for firewood is for sauna stoves. While many modern saunas are heated by electric heaters, the sauna purist prefers a wood heater. As well as being in all apartment buildings and hotels, they are in most homes and holiday cottages.
The price of private vehicle fuel is 1.39 Euros/litre (A$2.60), and the price of diesel is about 1.07 Euros/litre (A$1.80). Interestingly, in the period of WW2 when Finland was having to defend itself against two Russian invasions and was forced to become one of the nations allied with Germany, it had up to 43,000 vehicles converted to run on gas producers using woodchip as a fuel.
Currently the president of the EU, Finland has invested steadily in education, and now has the most highly educated workforce in the OECD or EU by any measure. By the intelligent use over 30 years of focussed funding into research, and loans from government and private funds, qualifying businesses are able to receive support while they develop products and export potential.
Part of the reason for Finland being able to capitalise on its vast private forest resource is though its transport infrastructure, which includes water as well as road and rail. The excellent rail network has dual lines on main routes, with extensive loading sidings at regular intervals allowing loading of logs onto several trains simultaneously. It is common for entire trains to be solely log wagons. The import of up to 20 million m3 of logs annually from Russia is mainly by rail.

1. Australian requirement for new options for thinning, and marketing of thinnings.

In dispersed sawlog woodlots in Victoria, we have a far easier situation for thinning than the Scandinavians or Finns in their mixed forest on variable terrain, often in the dark, often at subzero temperatures in deep snow. If the Norwegians can do cost-neutral thinning on rugged, inaccessible and small sites, we should be able to manage to do it here at a profit. It is important that the most suitable process can be developed or adapted for our conditions so that thinning be done before competition between trees significantly reduces growth rate. This may be between 3 and 8 years of age depending on site, rainfall and species. More simply, it is usually between a breast height diameter of 8-14cm.

We need a system that will allow rapid processing, and removal of the thinned stems from the woodlot for a cost of $10-20/tonne, depending on site. Preferably the system would leave leaves, bark and the tops on the bed of the woodlot, possibly as chip. This will require some mix of a high cycle rate and throughput of the machinery, a relatively low capital cost. For many dispersed sites on farms there may be scope for the work to be done using, as far as possible, existing farm machinery, and relatively low cost farm labour The process needs to be safe, and not excessively arduous, noisy or unpleasant.

While much of the large harvesting machinery is made in Finland and Sweden, so is a large range of smaller equipment, designed to be used on smaller harvesters, or on the tractor drawn forwarders, or mounted on a loading boom fitted on a mid-sized tractor. While the full sized equipment may cost up to A$1 million or more, the smaller equipment is a fraction of that. However in assessing any machinery option there are more important factors than purchase cost to consider. They include load capacity, load and unload time, road and transport speed, harvest head cycle speed, oil flow and pressure requirement.

A critical one is the oil flow requirement. Most older and mid-size farm tractors have quite small flow rates of 50l/min or less, suitable for only small heads and grapples. The smallest harvesting heads require flow rates of 80l/min or more, and pressures of over 17 Mpa. The larger ones require about 360l/min and 25 Mpa. So flow rate and working pressure governs the rate at which loading booms extend and lift, harvest heads open, close and cut, and at which a grapple will close and grip. This one issue of oil flow and pressure, plus the need for multiple remote hydraulic outlets, will preclude most sorts of farm tractor for forestry harvest purposes. However they can still be used with a drawn forwarder/harvester with its own motor-driven hydraulic pump.

The decision has to be made if the whole trees are to be removed and processed outside the woodlot, or whether they are to be felled, and delimbed and cut to length at the stump. The first option requires a simpler and cheaper felling/bunching head, but removes significant nutrient from the site (which could be returned at a cost). The second requires a higher cost head and higher capacity machine. It means the harvester's work output is less, but significantly reduces the operations outside the woodlot, and leaves nutrient-rich leaves and bark on the site. The options are broadly as follows (roughly in order of reducing price, and work capacity).

2 a 'professional' harvester – including the Scandinavian mid-size rubber-tyred machines.

3 a 4 wheeled excavator (such as those commonly used in road repair in Europe) (machines like this are common in Europe and are made by a number of companies including Liebherr and Kockums). Used with a mid-size felling/delimbing head.

4 a forest operations tractor such as those made by Valtra, with reversible seat position and dual outlet, high capacity hydraulics (75l/min, 20mpa). Used with a rear mounted boom with accumulating head, or smaller felling/delimbing head, followed by a drawn forwarder or truck fitted with a boom with grapple.

5 a mid-size tractor (60-90 HP) with dual outlet, high capacity hydraulics (80l/min plus, 20 mpa plus). Used with a 3PL mounted front or rear load arm with

accumulating head, followed by a drawn forwarder or truck fitted with a grapple boom.

6 a mid size tractor with single hydraulic system, mid capacity hydraulics (50l/min, 20mpa). Used with a trailer forwarder with the boom fitted with a grapple or smallest of the felling heads. Possibly following manual felling/docking team.

Examples of equipment options.

a. Simplest felling head/grapple combination. 245kg, 50l/min, 200bar, hydraulic knife. Example by Mecanil Oy of Finland. www.mecanil.fi
b. Felling head/grapple, approx 180kg, oil flow 30-80l/min. pressure 20Mpa, single hydraulics. Hydraulic knife. Example Naarva-Grip 1000-23. www.pentinpaja.fi.
c. Accumulating felling head. 360kg, 50-150l/min, 17-20Mpa, hydraulic knife, requires one hydraulic outlet. Naarva-Grip 1500-25E. www.pentinpaja.fi.
d. Felling/delimbing, chainsaw cut-off, 240kg, 80-120l/min, 18Mpa, 24cm max opening. Example K2 harvester. Metso-Metalli Oy.
e. Each of these above heads also requires a rotator fitted between the boom and the head to spin the head.
f. A 3PL boom and rotator/grapple, with stabiliser legs
g. A rigid rear mounted boom
h. A drawn forwarder with boom and grapple
i. A drawn forwarder with hydraulic pump, boom and grapple
j. A high capacity chipper with hydraulic feed and a throat of over 20cm sides

It is obvious that even with a good farm tractor with the necessary hydraulics for a reasonable production rate, an outlay of up to A$100,000 is necessary for a drawn forwarder with boom and grapple (Built-rite 612HD: $30,000), a smaller felling head (K2: $30,000 – Bracke C16 $50,000), rotator, and a tractor rear-mounted boom (Kronos:A$20,000).

This outlay obviously needs to be compared with alternative ways to thin, to assess the cost per tonne of thinnings on the ground outside the woodlot.

For the system to be able to put thinnings stacked outside the woodlot at $15/tonne (a usual pine thinning contract figure), it will require 7 tonnes to be felled, carted and stacked an hour at a gross cost of $100/hour. A tracked 20 tonne harvester and a 10 tonne capacity forwarder operating together will cost about $300/hour. In pine first thinnings, felling a row and thinning two outrows either side they may achieve 30-40 tonne/operator hour felled, carted and stacked, with a maximum forwarder cartage distance of 400m.

2. Value adding to harvested thinnings – firewood, chip, fuelwood, poles, pulpwood. Milling options. The forest owner association role in marketing.

Timely thinning operations are critical to the production of sawlog in Scandinavia and Finland. The forest management associations are the bodies who in each of these countries represent most, if not all ,of the multiple landowners who own the sites. In Norway the associations actually buy and sell the material to buyers and manufacturers. In Sweden some of the associations, such as Sodra Skog, are the principal buyer. In Norway some of the regional associations (including Agder telemark Skog) are also large enough and prosperous enough that they have become owners or partners in regional processing businesses. These include pellet making, sawmills, and pulp making.
In Denmark and Finland they principally operate on commission on sales revenue. An important function is to oversee the process so that it is properly performed to legislated standards.
To generalise - thinning produces at least three products: fuel wood, pulpwood and small sawlog (over 13cm sed, over 3.4 long). In Finland, buyers from larger processing business may make offers for each of the products of the site. If they get the sale they arrange the harvest. The harvesting contractors will plan their work across the area to achieve the most rational travel. The terrain, the diameter of the product, the access – all are considerations. Thinnings tend to be done in summer when long daylight hours help in this fiddly work, unless the site is low and access is impossible unless it is frozen solid.

Fuelwood is produced from tops, smallest diameter thinnings, thinnings of otherwise unwanted species, and stumps. The fuelwood is often chipped at the edge of the site and transported straight to a combined power and heating plant (CPH), or a community heating plant. In many parts of Finland and Sweden these centralised heating plants are in almost every town. Some larger plants can use as fuel the bundled tops produced by one of several machines that can pick up the harvest waste and bundle it into 500kg cigar-shaped ‘logs’. An alternative to bundling are the in-field self-propelled chippers that chip this nutrient-rich harvest waste. Though Valmet makes a biomass harvester-chipper combination, these field chippers are normally supplied by forwarders, and empty the chip into bins on the forest edge. Larger CHP plants in Finland may have the large powerful tub grinders necessary for reducing stumps to chip.
There are issues with removing this nutrient-rich product and with using it as fuel. With clean wood chip the ash remaining is a relatively small fraction. With combustion of this harvest waste the ash can be as high as 25% of dry weight. The disposal of this ash can be problematic, though some ash (particularly that extracted from the flue gases) is presently being pelleted and spread back into the forest.
Individual forest owners and small syndicates are already converting their thinnings into even sized chip, and using it for heating of houses, businesses, apartments, schools and other institutional buildings. In Scandinavia the biomass fuel of choice is the pellet. These are conventionally about 1-1.5 cm long, 6-8mm diameter and about 9-12% moisture. Normally they are produced from sawdust from manufacturing processes, though machinery is available that can hammermill woodchips into woodflour, dry and then pelletise it though heavy steel dies. Enormous volumes of pellets are now being produced and traded between the European and Scandinavian countries and now out of Russia, with one CHP plant at Averdore, south east of Copenhagen, using 300,000m3 of wood pellets annually, sourced from Junkers, Denmark’s largest flooring company.
The heating of schools has received special encouragement in the northern states of the USA. Here the Fuels for Schools program has seen many school councils decide to convert school heating from electricity, gas or oil to chip, sawdust or pellets, usually with good cost

savings. States where this scheme is most adopted include Vermont, Utah, Montana and Wyoming.
Fuelwood of course also includes firewood billets. The production and marketing of these is very obvious in Norway, where pallets of split billets in netting bags, usually produced by machines of the Haake Pilke type, are for sale at the side of the road in many places. The production is usually quite small scale and localised. It generally uses lower quality hardwood timber like birch thinnings, though the premium priced firewoods are the denser hardwoods like oak and elm.

Pulpwood is usually of birch and conifer. In a thinning on a good quality site pulpwood may compose up to 50% of the harvest. Cost of transport is critical in determining whether this material goes as pulpwood or as fuelwood. Often the value at the harvest site is quite similar.

Small sawlog. In Scandinavia logs of the conifer species are bought and milled down to 13cm sed diameter and 3.4m length. These smallest sawlogs are a marginal operation and simply a part of the overall harvest. The harvester driver will have received the necessary instructions information on price before harvest and will process logs accordingly to get the best return for the overall harvest. In a longer harvest further instructions may come to alter the harvest format if a new buyer offers more for another product.
In the USA the Timber products company, the second largest plywood manufacturer in the USA, takes soft wood logs down to 12.5cm sed at its small log mill. It takes 4 seconds to peel the 8m of ply of, leaving a 5cm log core. This is chipped and processed for pulp or used to fire the plant’s boiler.

2 Bioenergy and biofuels principles, costs, economics and marketing by association

Biofuels divide into

a. Woody biomass. This is as firewood, chip, pellets or sawdust. Its most efficient use is for heat production, but it can be used to drive steam turbines to generate electricity.
b. Ethanol. This is produced currently in large volumes though fermentation of starches as in maize or corn, or sugars as in sugar cane. There is work going on in many countries to solve the problems of how to break down the lignin and cellulose in woody biomass to become a base material for fermentation
c. Bio-diesel- from rapeseed or canola oil, or various other plant oils, put through a catalysis process to form the methyl ester of the oil. Animal fats can also be used.
d. Biogas - from anaerobic breakdown of plant or other organic materials (such as organic waste or animal manures) releasing methane and some other flammable gases. Once it is purified and water removed this can be used directly to power transport, for heating, or used to power generators for electricity production.
e. Hydrogen-rich gases produced through pyrolysis. When sawdust or chip is heated in a pressurised reduced-oxygen atmosphere the gases produced can be condensed and fractionated to produce qualities suitable as diesel, petrol or LPG substitutes. This is a more refined version of the WW2 gas producer.

Biofuels do not have to be used in a pure form, but can be used to dilute fossil fuels. For instance in the USA woodchip is being trialed as a mix with coal at up to 10%, with significant reductions in sulphur dioxide and nitrous oxide, as well as a 10% reduction in net greenhouse gas emission (higher ratios have been trailed using woodpowder). Commonly the ethanol/petrol mix is 10/90, but Brazil, the USA and Scandinavia are increasingly using the 85/15 blend. Bioethanol can be used to dilute fossil diesel or biodiesel, and biodiesel can be used to dilute fossil diesel.
Costs of energy from woody biomass are usually significantly less than from competing fossil fuels. However the use of woody biomass has severe limitations. Cost of haulage is important. In the USA haulage beyond a radius of 80 km is regarded as not viable. According to the Forest Products Laboratory 'the initial costs of a bioenergy fuel system are generally up to 50% greater than for a fossil fuel system, due to the fuel handling and storage requirements.
The Swedes are leaders in developing use and processing of energy crops such as salix willow. Salix is a 20 year crop (hence lower cost than annual crops), with cutting before stems average over 50mm near ground level. Of the 300 species and cultivars of salix, only four are used. It is planted as cutting and rapidly achieves canopy closure, growing 5-6cm/day over summer. It produces a good quality dense chip with lower mineral content than annual crops. It tolerates irrigation with waste water.

Rules of Thumb

- 'Today the installed costs of a 1-1.5 million Btu/h (0.3-1.5 MW) wood fuel burner boiler system is estimated at US$50,000-75,000 per million Btu/h (0.3MW) of heat input.'
- A tonne of woody biomass burnt an hour can produce about a Megawatt of energy.
- Over 50% of the tree becomes waste in the manufacturing process and is available for energy generation.
- Use of woody biomass fuel can reduce institutional heating costs by 30-50%
- Installation costs can be recovered within 6-15 years, depending on relative price of fuels.

Websites

Biomass heating systems for schools and institutions in USA – www.fuelsforschools.org
USA department of energy, Biomass program – www.eere.energy.gov/biomass
USA national renewable energy laboratory, biomass research – www.nrel.gov/biomass
Ene Energy, a Swedish energy company using biomass – www.enae.se
Vaxjo municipal website re reducing CO2 emissions – www.vaxjo.se

5 A Norwegian Forest management association: function, management, relationship with forest owners, income streams.

'100 years ago the forest industry didn't pay well and bought direct from individuals. It wasn't a good situation, and the association formed and was very successful'. Director of Agder-Telemark Forest forest operations division.

In Norway now there are nine regional associations of forest owners, which are financially and administratively independent from each other, but which contribute a share to the cost of maintaining the central office on the basis of their harvest volume. The central office of about 20 staff works on certification development, lobbies government, and generally represents the organisations' and growers' interests. The combined organisation is called Norway Skog

Agder-Telemark Skog (normally called AT Skog. Skog means 'wood' or forest') covers the south-east corner of the country. This forest owners association has 8500 members, divided among 54 local forest owner associations, with an average about 120 in each group and ranging from 36 to 280. The average forest holding of members is about 50ha (the largest forest holding is about 10,000ha), and in the last year 2853 members (or nearly 30%) had harvest of some sort. Only about 5% of the forest owners with over 4 ha in the region are not members (though some non-members are also the largest landowners).

AT Skog is a private company that is presently going through a restructure that will result in its members owning shares and being entitled to annual dividends. Introduced in 2006 and similar to the system used by Swedish forest owner associations, the price members pay for shares depends on the forested area – so an owner of 50ha can buy up to 4000Kroner of shares. Up till now members paid a flat 400 Kroner (A$90) annually.

Presently, after costs, its profits are returned to its component local branches. It has 55 employees and has an average annual turnover of about 450 million Norwegian kroner (about (A$90 million). Last financial year the association income was 481 million NOK. Approximately 20 million NOK (A$4 million) was operating costs, and the net profit before tax was about 72 million NOK. Of this about 68 million NOK (A$13 million) is returned to the local groups.

The staff of 55 is split between a number of offices, with 20 in the main office. The top managers are here, along with many of the organisation's economists. AT Skog is divided into divisions of Marketing, Forest Management, Extension, Certification and Economic. AT Skog has a wholly owned business, employing about 20 people, called AT Plan, which specialises in forest planning.

AT Skog makes its income mainly from trading in logs, pulp wood and fuelwood. It provides advisory services, arranges, manages and oversees harvesting, and is a partner or owner of a number of timber processing businesses. It receives useful income from its sizeable shareholding in Norske Skog – the global public timber milling and paper maker. It is an investor in research and is currently a co-investor, with Norske Skog and Norske Hydro among others, in developing and commercialising the production of biofuels by the pyrolysis of woody biomass.

In 2005 the organisation marketed about 1,030,000m3 of timber, split roughly evenly into sawlog and pulp logs. Most of this is Sitka spruce, then fir and Norway pine, and followed by relatively small volumes of the broadleaves – oak, ash and birch. The association handles about 70% of all logging in its region, with members increasingly passing the job to them.

The AT Skog marketing department sells sawlog and pulpwood to a small number of regular buyers at negotiated prices. To fill these supply contracts it then buys wood from its members. The key element in this process is a group of 19 district-based full-time buyers (who are mostly forest owners and members of AT Skog themselves), who have a set quota of about 40,000m3 each to procure annually. They know the sale price, so they know what

they can offer. They know what members have that is at or near harvest point. They are in regular contact with the forest owners in their area. Their aim is to have 100% of the coming month's harvest sold and the harvesting contracted, 70% of the following month, and 50% of the third month. These district representatives will also source wood from non-members, though at a discount of 15-20 NOK/m3. In some districts and years up to 40% of the logs are from non-members. Members will have some harvest work once every five years, though with smaller forest owners it will be as seldom as every 20 years. In 2005 about 700,000 m3 was harvested on members' land, with 580 ha replanted.

AT Skog is the largest buyer and has about 90% of the market share of log sales. In 2005 prices were negotiated for the full year, but the buyers can move prices in a small range to try and stimulate activity. Overall AT Skog is trading on a margin of only 5%, which is the lowest of all the regional associations.

AT Skog not only is a dominant supplier in its own area, but it has the interesting situation of buying mainly from its own members and selling a significant fraction of its logs to itself. Presently about 80% of the logs go to Norske Skog (in which AT Skog is a shareholder) and three other sawmills, and a paper mill. One mills buys 50-60,000 m3 annually. Another buyer with 2 big sawmills gets about 30,000m3. AT Skog is a 30% partner in a pulp mill using 700,000m3 annually. It has a 50% stake in a woodchip briquetting factory that uses up to 2000m3 annually. It has a 49% stake in a modern sawmill that uses up to 80,000m3 a year. The future of this mill had been in doubt until AT Skog bought into it assuring supply and improving its marketing.

Much of the forested area in AT Skog's region is difficult to access. *'It's a challenge. Much timber is on small properties, on poorer access roads, further from markets, often in steeper country, often with absentee owners who are hard to contact'*. But to date AT Skog claims no owners have had to have thinning done at a cost. Due to good organisation and efficient machinery operators and transport it is at least a break-even deal.

Harvest is arranged by AT Skog, usually using one of the contractors favoured by them. Owners may have to pay to have roading works done at a cost of 200-300,000NOK/km. This may be shared between neighbours, and in some cases the commune may contribute. The buyer pays cost of transport. In the AT Skog area there are 50-60 self loading trucks, mostly equipped with GPS. These are able to load about 45m3 in 30 minutes, and normally transport within 50-100km radius.

Costs of logging are about 125NOK/m3 (A$50/m3)including AT Skog administration charge of 8 NOK/m3. Price at the roadside for spruce sawlogs is about 400 NOK/m3 (A$80/m3). For spruce pulp wood it is about 230 NOK/m3. Fuel wood (timber that has rot, or is too small diameter) may be separated as a third class if there is a market within economic trucking distance. The average gross log sale price for a final harvest site is about 300 NOK/m3 (A$60/m3) so generally the owner nets about 175 NOK/m3 (A$35/m3). Return for a second thinning site may net the owner 30-40 NOK/m3 (A$6-8/m3), with the contract thinning cost varying with the site and size of trees and size of harvest area.

In one 60ha site visited near Notodden, 2500m3 of first thinnings were being removed at about 40m3/ha. The owner was being charged 200NOK/m3 by the contractors, and was being paid 210 kroner/m3 by AT Skog. Harvest was contracted to a family company running modern Valmet equipment. The harvester worth about 3.4 million NOK (A$750,000) including the head operated on two shifts, and produces 70-80m3 a day.

Harvest on this site was relatively straightforward. It was an undulating sloping hillside, with some hollows, but few outcropping rocks. As the site abutted other private forest sites on three sides, boundaries and corners were identified by GPS. Track lines 45m apart across the site were marked by ribbon tied to trees. In this site, because of the prevailing prices for different species, the spruce component was being removed and the pine component left to grow on. The initial 2500 sph was reduced to about 1000 sph.

Since the trackways across the site require removal of 16% of the total trees, the thinning of the balance is calculated to allow for this. The aim is to thin before trees are taller than 18m, and preferably around 12-13m. This is to minimise problems with instability, and losses due to winter snow burdens and wind. The outcome is always to leave a stable area of good quality well-spaced trees post-harvest. These decisions are principally left to the harvester drivers, who are required to juggle decisions on length diameter, species, and timber grade, while maintaining direction and avoiding damage to machine, ground and remaining trees. A skilled harvester-driver can significantly lift the owner's returns for a final harvest as there can be 200 NOK/m3 difference for the best logs if they are taken out to the optimum length of 4.9m, provided they are over 20cm sed. Harvester drivers have to do two years of training and then two years on the job before they get a full license.

A final harvest site is small and in very steep sided gullies. It has a 1 year-old owner-operated Valmet machine which is harvesting about 100m3 each 12 hour day. Along with a large capacity forwarder it produced about 32,000m3 the previous year with a 3 man team. On this site part of the access track is so steep that for best traction the forwarder has to reverse its 15-20 tonne load out. Logs are being graded as sawlog here that are only 16cm diameter sed and 4 m long for a better price than graded for pulp. It is possible to cut sawlog down to 13cm sed and 3.4m long but the price is better for these as pulp.

Ivo, the owner, has been working in the timber industry for 36 years ('It's not for the money, it's for the lifestyle' he says sardonically, rolling a cigarette). Fuel cost is now a significant issue, with the harvester using 200litres every 10 hours, or 50,000 litres a year. This translates into 4-500,000 NOK (A$95-100,000) annually. He owns and does most of the servicing of his own machines, and turns them over every 4-5 years. He works year round, mostly on contract.

AT Skog has two forms of contract: one for reliable contractors with a good record, and another for new contractors or those who need tighter specification. Problems usually arise though contractors going too fast, not adhering to specifications, or cutting across boundaries. For smaller sites of about a hectare about 10 trees are meant to be left, often as a small copse, or along a watercourse or inaccessible area. These are supposed to be the oldest and biggest trees of the best form (usually of the more valued species) to act as seed trees. Dead stags are also often left, and those marked as habitat trees, particularly those with hollows. The remnant trees are seen as being the source of, as well as seed, the source of a necessary insect and micro-organism diversity for a healthy forest.

Certification is a key part of the AT Skog approach. Norway has developed its Living Forest Standard criteria, which are based on and compatible with the PEFC system. So all members are being assisted by AT Skog to become compliant with Living Forest. The costs are initially very high. Comprehensive plans are being drawn up for all members' sites. The plan maps contain information for each site on topography, species mix, age, area, and show watercourses, swamps, outcrops, set-asides and any reserves or habitat trees. Doing the plans for sites will cost up to 1.5 million kroner (A$300,000). This cost of 20-30kr/ha is largely borne by AT Skog. Plans are valid for 10 years and then need to be revised. The mapping is done for a whole community at one time. Begun in 2001, the mapping process will take another 5 years.

To gauge compliance of management and harvesting works with Living Forest, 4% of members' harvest sites are audited internally by five AT Skog officers, including a review of all the paper work involved with the sites. After harvest the site is inspected, and problems identified. Out of a number of sites visited, problems included bad washaways on a steep forwarding out track, defective replanting of spruce seedlings, and inadequate remnant trees left on site. Height of stumps is checked with 95% to be cut below 20cm. Cultural sites are checked, with trees on grave mounds for instance to be harvested clear and the mound not to be tracked over. The cost of development of certification is about 2.5 million NOK (A$500,000) per year, with the owners absorbing some extra costs. For

instance one requirement is that 10% of the trees of any site are set aside, so this equates to about 30 kroner/ha of foregone income.
The overall cost of certification is estimated at 20-30 million Kroner (A$4-6 million), being largely due to the overall cost of the administrative time for monitoring, with 100-250,000 Kroner being the actual cost of auditing. AT Skog regards the introduction of certification as having had a net positive result with generally a great improvement in forestry management by members. It also assists in better resource monitoring, with AT Skog knowing now that while they have a harvest of 1 million m3, they have an annual increase of about 2.3 million m3 available and accessible, and hence the scope to harvest up to 1.5 million m3.
Native animal monitoring, hunting and recreation are also aspects of forest ownership that AT Skog is involved in. Five officers are working with landowners assisting development of such things as hunting leases. Moose are a constant problem for browsing of seedlings, with licenses given for shooting up to 600 moose a year in the Notodden area. There is also a season for wild reindeer (the smaller cousin of the Canadian caribou), elk, roe deer, and beaver. Bear and lynx, and very occasionally wolf, are also seen in the area.

Agder-Telemark Skog is run by a committee of seven directors, with five elected from forest owners for terms of three years, and two nominated from the employees. At the AGM representatives from each of the 54 branch associations vote for directors nominated from branches, with branches that harvested more than 25,000m3 getting a second vote. The chairman is re-elected every year.
The Gjerpen group is an example of the branches, and their production. Its members are located around the regional city of Skien, partway between Olso and Kristiansand. Of its 168 members 40 delivered timber to AT Skog, with 2245m3 of spruce sawlog and 3374 of pulplog, 816 m3 of pine sawlog, 213 of pine fuelwood and 213m3 of pallet timber. 1000m3 of birch logs went to pulp. The total was 8394m3 worth 2,400,000 Kroner (A$500,000).
The branch members receive training and assistance in forest management from AT Skog. Part of the training comes from instructors based at the Forest Competency Centre (Activt Skogbruk), centrally located north west of Oslo at Biri (near the town of Lillehammer). This centre, developed with funding from the regional associations, employs 8-10 instructors to travel to branches and give technical training. This includes chainsaw training. Insurers require any forest owner to have done a chainsaw user course. The centre has the facilities to offer residential courses.
Websites:
Agder-Telemark Skog - www.atskog.no
Norwegian forest owners association – www.skog.no

6 Finland: Forest owners, branch, district forest owner union, and association with the farmer union.

All Finns with more that 4 ha of forest must join forest owner associations by law. There are special laws governing association's activity, with one being that they are restricted from buying or selling logs. The associations are non-profit making.

The first forest owners association in Finland started in 1906 at Tervo, a community in what is now the Siso-Savo district. It was largely due to dissatisfaction with the harvesting approach of the sawmilling industry. It became a movement that spread across Finland and now involves 900,000 forest owners, organised into hundreds of local branches. The Siso-Savo forest owners association is based around Suonenjoki in central Finland. It has a total staff of 18 spread across 6 offices, with four staff in the Ruatalampi office and five in Suonenjoki. It has a membership of about 3000.

It holds the group certification under the Finnish Forest Certification standard (FFCS). About 33% of the FFCS auditing cost is born by the union, and 66% from the forestry companies. It takes about a week for 5-6 people from Norske Veritas to do auditing and costs about 20,000 Euro/year.

Membership fees for forest owners are calculated per hectare. 25 Euro is the base fee, with 3E/ha added, to a maximum of 5000E. In return for this fee members receive newsletter, field days, discount seedlings, mapping services, certification, insurance (including against animal damage), contracting services and overseeing of private contractors.

Siso-Savo is one of nine associations linked into the Northern Savo Union of Forest Owners. The combined membership of the Northern Savo Union is about 23,000, with a combined forest area of about one million ha. The 80 officers within the union are spread over the branches, with only two being based at the Union office in Kuopio.

Northern Savo in turn is one of 13 forest unions within Finland that in combination represent all forest owners. Three of these unions on the west coast are Swedish speaking, but work within the Finnish system (one trades more into Sweden). The Finnish forest owners are an important group within MTK, the union of Finnish Farmers and forest owners.

The main function of a local association is in assisting with sales, and overseeing works on its members' sites. While in Finland the member is responsible for contacting the buyer and arranging the sale, the association can play a major role. About 40% of sales are assisted by forest officers acting under authority for the landowner. About 30% of landowners are absentee, so for these members the association will act under a signed authority for a cost of 0.40Euro per m3. The average costs to landowners is 32 Euro (a maximum applies). For this cost an officer will measure the site, and oversee contractors.

In the Northern Savo union area with its 26,000 members, growth increment is about 5.2 million m3. Average harvest over past years has been 4.5 million m3. Overall 52% of harvest is sawlogs and 46% is pulpwood. 21% of sites are 4-10ha (most are less than 4ha). Increasingly member's total forest area is smaller. Less than 1% of members have over 500ha. The view is that a full income from forestry requires at least 250ha if the owner does the work, and over 500 ha is required if the work is done by contractors.

The associations can be agents in buying and selling. Of the 23,000 members, up to 1000 will have changes in ownership any year, though often this is within the family due to death and succession (forest owners have an average age of about 60, with 30% over 65), or divorce. Of the 1000 changes in title about 100 involve transfer to new owners.

The associations can contract to do thinnings in forests too small to interest any contractor, and since 1996 are permitted to deal in fuel wood.

The Siso-Savo FMA has 4800 members with 195,000ha of forest, and goes across the borders of six communes (municipalities). The average stand has about 123 m3/ha, and the total forest volume is 24 million m3. Harvest is usually about one million m3 (members in 2005 sold only about 623,000m3 for a return of about 21 million Euro (A$35 million. This 35% reduction was due to a change in the income tax assessment on forestry income).

New planting covers 1850 ha (in 2004), and about 2200 ha were cultivated for replanting in 2005. There were 1200 attendances at night classes and forest management education days. This training also included a 'Women in the forest' course, which ran for six months of one evening a fortnight. The number of women owning and managing forest is increasing and is about 30%.
The Siso-Savo association owns about 200ha of forest on five sites, which provides some income. Its principal income comes from planning and advice on timber sales (up to 40%), forest management fee (20%), fees for service, management fees for absentees ownerers, rent on office premises, and contracting services such as replanting (employee numbers go from 5 permanents to 6o in peak season), and planning charges. Its annual income is about 2 million Euro (A$3.6 million)
All sites are planned and entered into a comprehensive data base accessible through the branch office. The computer and communications officer at the Suonenjoki office listed the material that is included on the plan for any site. It includes aerial photo access, ages and species of trees, area, location and neighbours, stem density and stage of management. It includes the title detail including commune, village, forest planning area, forest plan number, central reference number, and tax information.

A Finnish forest owner - One of the larger forest owners in the Siso-Savo area has about 750ha. His family has been in the area as large landholders since the 1690s, and the holding has changed from grazing and cultivation to forest, mostly in the last 50-80 years. Much of it is still only in the second or early in the third rotation since the introduction of the 1886 Forest Law. It is in about 300 lots of area 0.4 ha to about 10 ha. Each site is different in some clear way from adjacent lots, either in age or mix of species, or in soil conditions. Since his sites are in a number of large blocks he has boundaries with about 20 other landholders. The practice of having a clear gap along boundaries, and having all forest holdings mapped and GPS-ed means little scope for disputes.
He sells about 2-3000m3/year and makes the contact with buyers himself, aiming to get offers from 5-6 companies. Buyers come and assess the site and will make an offer. Some from the larger companies will give a price covering all the products, while some smaller more specialised buyers will only make an offer for sawlogs or pulp logs or fuel wood. So Stora Enso, Metsalitto and UPM Kumera are paper making companies who also have sawmills. While it may be that he will sell the three products separately, it would be more normal that one buyer will take the lot, particularly if the bulk of the harvest is thinnings, and so destined for pulp. However if he has good quality sawlog, as he has this year, it is more likely that a specialist sawmill will give the best price. The buyers select the contractor. Harvest time is decided in consultation with the owner and often dictated by the ground conditions. A lot of his lower country has to be harvested in winter as it is too soft in summer. The management plan has detail on which stands are to be harvested in which 5-year period, and this is normally followed. Harvesting tends to be in smaller areas, and this is favoured by the certification guidelines, but there is no hard and fast rule.
The market for biomass is still relatively new. The local heating or Combined Heat and Power (CHP) plants are quite small, and they may be supplied by a regular small group of farmers.
The big plants at Kuopio or Uraskele are the likely buyer for his biomass, and Uraskele has a stump muncher so is the market for his stumps. While biomass used to sell at about 20 Euro/ha now through the FMA it is paid per m3 or per MW. Generally it is only break-even, with a small government subsidy improving the economics.
Each year this landowner plants 10-20 sites and clear fells 5-10 sites. He has up to 10 sites given a second thinning and 10 to 20 get a first thinning. Overall 10-20 ha a year is being worked on in some way with clear felling on only two or three ha. Planting is normally into turned over spots, where a divot about 300x300mm is turned over and a spruce is planted on top.
Moose damage to spruce seedlings is always a potential problem so at this time salt licks are put out for moose in some areas where trees are at least half grown. Moose browsing, and to a far lesser degree beaver dams flooding lower lying forest, are an annual problem for the landowner. On the plus side the hunting and eating of moose seems to be a major activity, and source of much enjoyment, interaction and cooperation between neighbours.

A Finnish district heating plant – the plant at Savon Voima generates about 5.5MW. While it burns peat briquettes in winter, for spring and autumn it switches to woodchip. Peat has a higher energy density, so while the plant uses about 100 m3 of peat in 24 hours, it uses about 160m3 of woodchip for the same period. The chip can be up to 40% moisture, and whole-tree chips of 5-20cm are used. The chips are moved by loader from a outdoor dump onto a moving floor and then augured up to a gravity feed hopper, and from there into the boiler. The peat is about half the running cost of oil fueling. Chips cost slightly more than the peat partly due to the extra labour required.

The heated water goes in a loop of many kilometres, serving a hospital, a school, a spa, some apartment buildings, and clusters of private houses. About 300m3 of water is held in the loop. It leaves the plant at about 70-120C depending on the weather, and runs through buried insulated pipes. At each premises a small diameter pipe leads off and passes though heat exchangers. By the return to the heating plant the temperature has dropped to about 40-50C. Each premises has a meter that registers MW useage.

The heating plant built in the 1980s is now inadequate for the community and a new one is being built that will deliver over 10 MW. The present one has a single manager. He is able to load enough chip to allow the plant to run for up to two days, with an auto feed system. The whole plant is run though a computerised system that will alert him to any malfunction while he is off duty. It has a backup system using heating oil that can be used to maintain service if the biomass feed system needs to be repaired, or at times of peak heat demand in cold winter spells.

The northern Savo forest owners union has a bioenergy specialist (funded by the government and the EU) who works with farmers and communities to help promote the best use of bioenergy in the region. The aim is that all communities have a central heating plant fuelled by biomass. This is already the case in some other regions.

The largest district biomass-fueled CHP plant is the Stora Enso plant at Paivionsari, which uses 2 million m3 annually. The biggest biomass fuelled CHP plant in Finland, at Pietarsaari, is owned by UPM Kumera, and generates over 500MW.

Biomass is presently bought either by the MW or the m3. The two figures are approximately equal for an average load of chip, but buying by the MW means the power plant is likely to get drier chip uncontaminated by dirt or snow. MW is calculated by density of dry sample, so requires a sample to be oven dried. Local plants are paying approximately 12-14 Euro/MW for biomass, while larger CHP plants tend to pay about 9-10E/MW.

Conclusions

In the areas of sustainable forestry management, and in awareness of bioenergy, Australia suffers by comparisons with the Scandinavian and northern European countries. Even the USA has re-oriented itself and has an apparently coherent bioenergy policy, partly built on the enormous biomass volumes resulting from its Healthy Forests legislation. It is time that we followed suit. The potential benefits are enormous. So are the costs of doing nothing.

Recommendations

1 The impediments to NIPF, including investment into NIPF, must be removed. Australian federal and state governments should kick-start the NIPF sector as a matter of highest priority. The potential outputs of this sector are impressive

- biomass production for decentralised generation of CO2-neutral heat and electricity, and for production of biofuels
- replacement of imports of paper and plywood, and rainforest hardwoods
- a more diversified and prosperous rural economy
- greatly increased carbon sequestration
- improved farm productivity
- improved habitat
- alternative firewood supply, reducing pressure on native vegetation
- mitigation of salinity, erosion, improved water quality
- more stable rainfall patterns, improved farm microclimates

2 We should encourage import of suitable machinery for early thinning of hardwood woodlots.

3 We should review the science, currently being accepted unquestioningly, of the influence of plantation trees on the water cycle, and the part that forest plays in the rainfall patterns.

4 We have no production of pellets, and yet pellets are the most suitable form of biomass for household and institutional heating. Businesses presently are paying to have sawdust removed. Pelleting machines are available for all scales of sawdust availability.

5 Woodchip is a useful fuel for industry, or for power plants - including coal fired power plants. The fuel value of much of our harvest and processing waste is being ignored. Timber from demolition and remodelling is often dumped.

6 Decentralised community energy production should be examined. Flammable household wastes are major cost, when they can be a major source of energy. Work needs to be done on developing a new look at municipal energy production.

7 The Greenhouse gas emissions from agriculture can be significantly reduced. Biogas production from animal manure and food processing waste is one option.

8 Other sources of bioenergy need to be identified, encouraged and utilised. Straw is clearly one source that can be readily converted to energy.

9 Pulplogs in Scandinavia and northern Europe come entirely from the general harvest process. The same could be the case in NIPF harvests here. We need to encourage the development of the industries that can utilise all grades of harvested material.

10 Development of a viable and productive NIPF sector relies on development of effective grower associations which will manage it. There is no better option. The growers are the primary group which will identify research and development priorities for the NIPF industry. Research bodies should be funded to allow some level of response to NIPF needs.

11 Both heating and cooling can be produced most cost effectively in community plants. This is particularly relevant to new urban developments, or institutions such as retirement homes.

12 Training and support for non-industrial private forestry owners is presently ad hoc and inadequate. Remedying this failure is urgent.